# OLD MINES REQUIRE NEW THINKING

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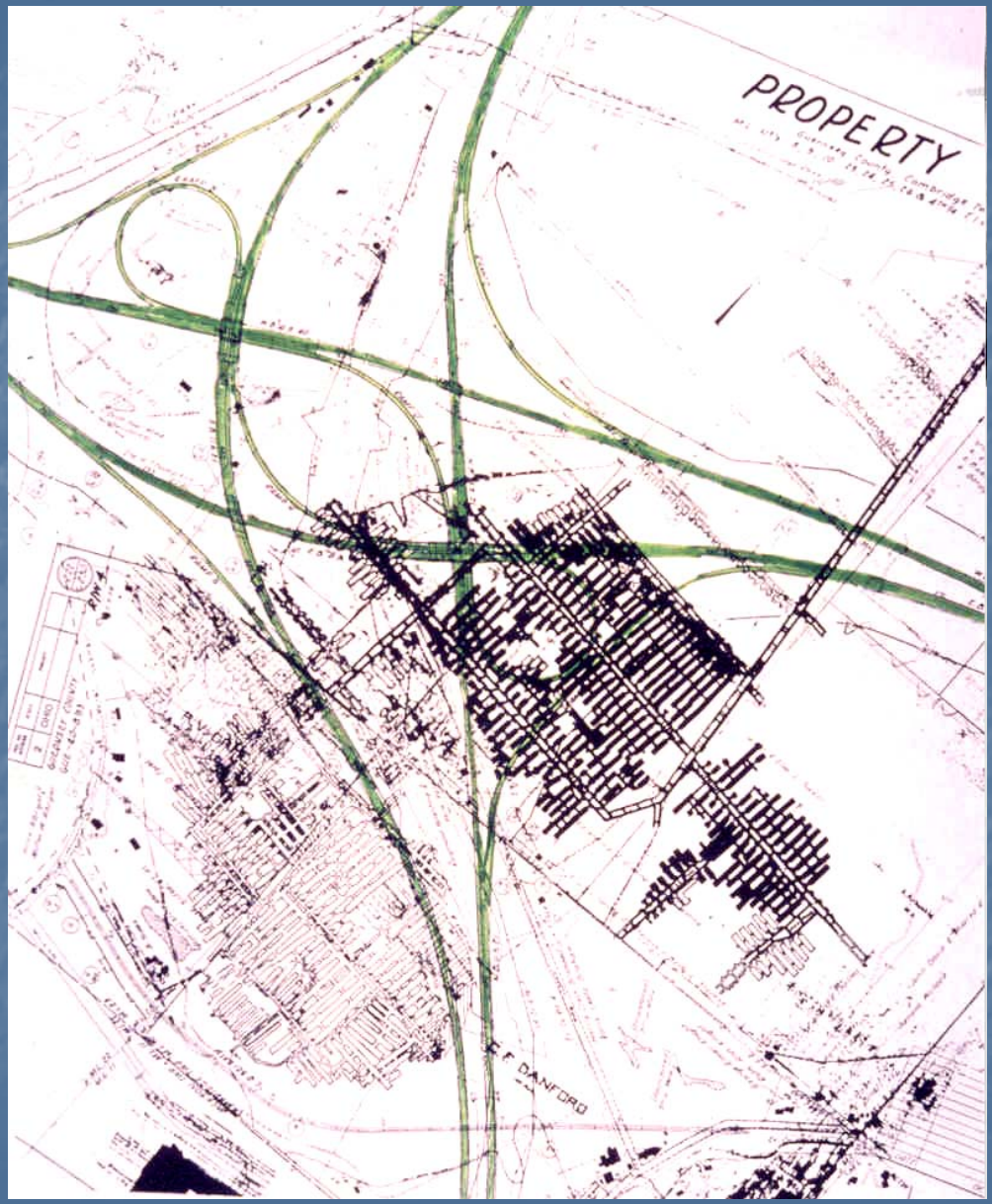
Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

FEDERAL HIGHWAY ADMINISTRATION
FHWA
OHIO DIVISION


PROPERTY
E. F. DANFORD

# Mine Problems

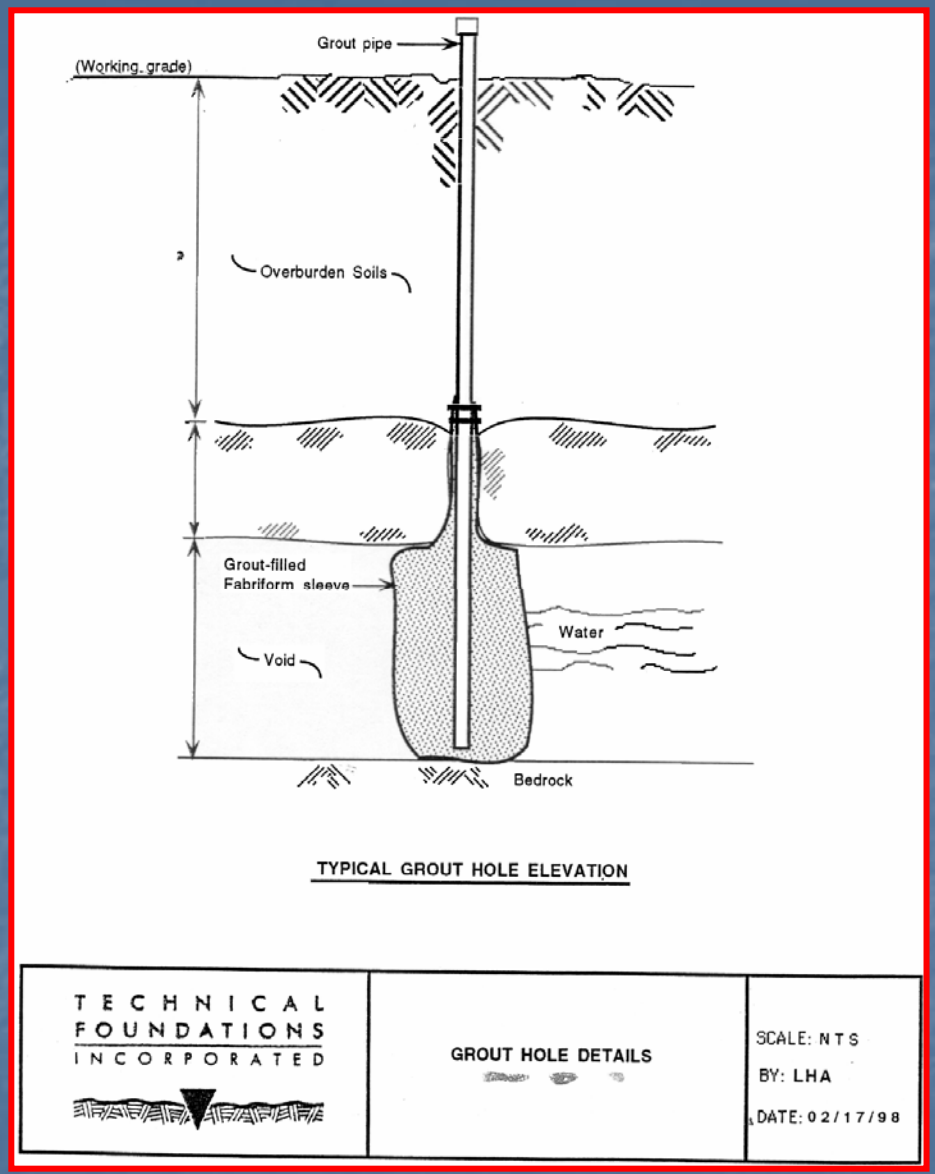
- Subsidence
- Slope Instability
- Flooded Mines in Slopes
- Acid Drainage
- Waste
- Fire
- Endangered species habitat

# Effect of mining on Transportation Systems

Collapse of old workings
Norwich 1988

KOMATSU

Typical bag installation procedure. One bag being filled, the next boring being drilled, and the next bag fastened to grout pipe with rubber bands ready to install.




Typical grout bag installation details.

HUESKER
HUESKER

# Design of bridges to cater for mining subsidence

Wichert truss foot bridge using concrete bearings

# Design of bridges to cater for mining subsidence

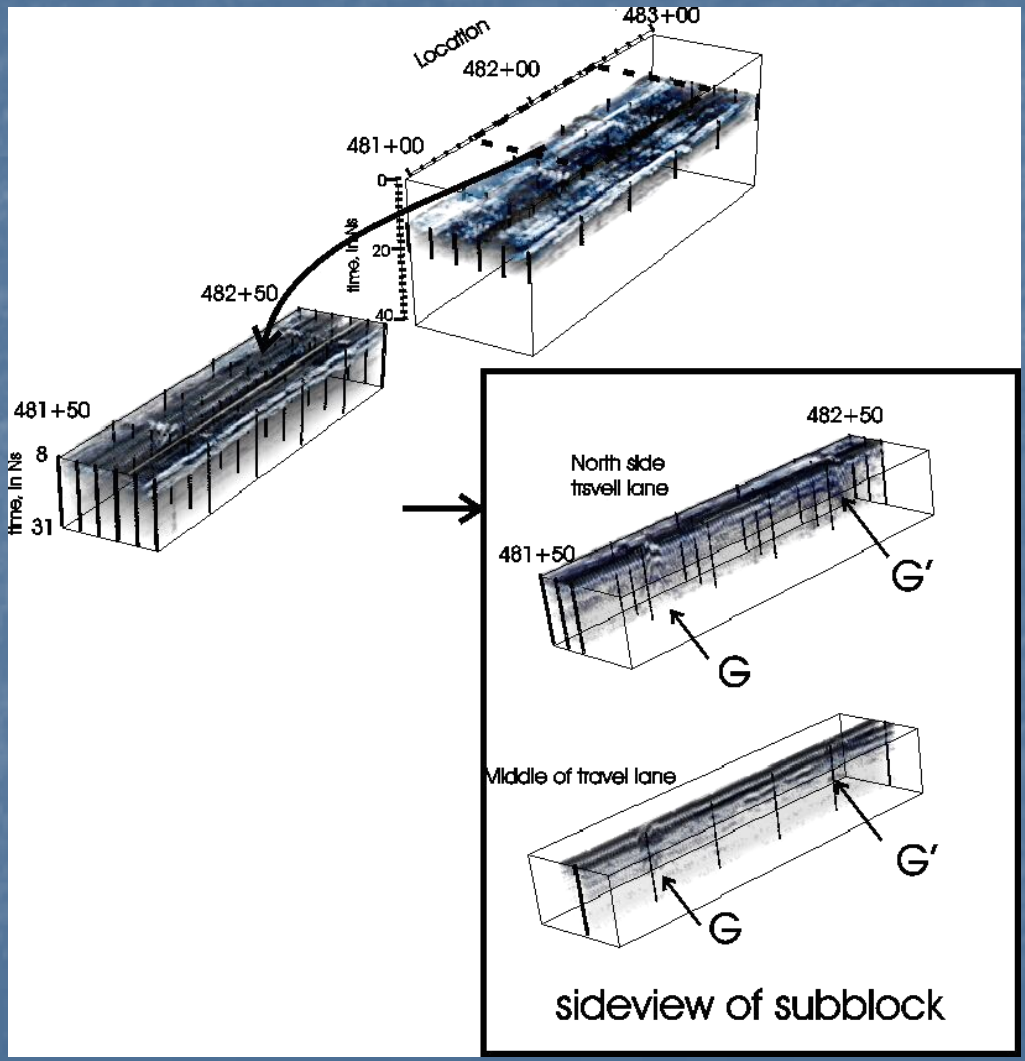
Bridges  subjected to 11 components of movement
Dual 3 lane bridge:

- Differential settlement of 600mm
- Change in span length of up to 300mm
- Twist of deck of 1 in 20

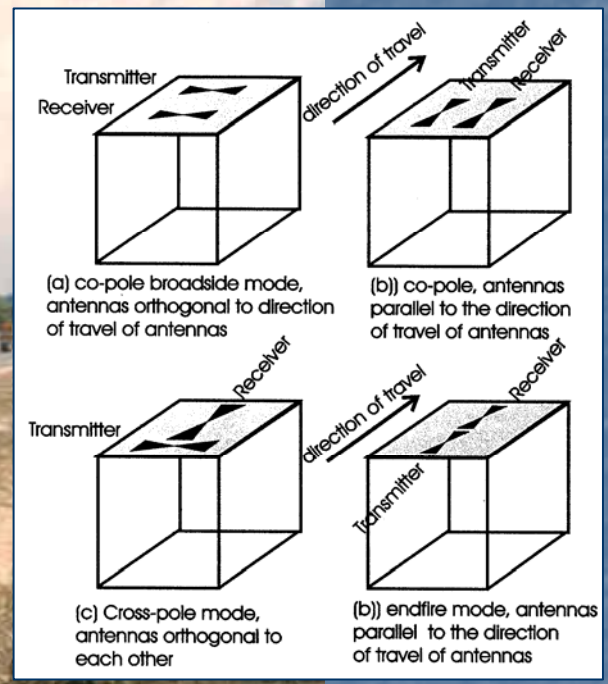
BECKWITH
MACHINERY COMPANY

# Radar

# 3D!


Location
483+00
482+00
481+00
0
20
40
time, in Ns
482+50
481+50
8
31
time, in Ns
482+50
North side
frsvell lane
481+50
G'
G
Middle of travel lane
G'
G
sideview of subblock

# Side Looking Underground Radar (SLUR)

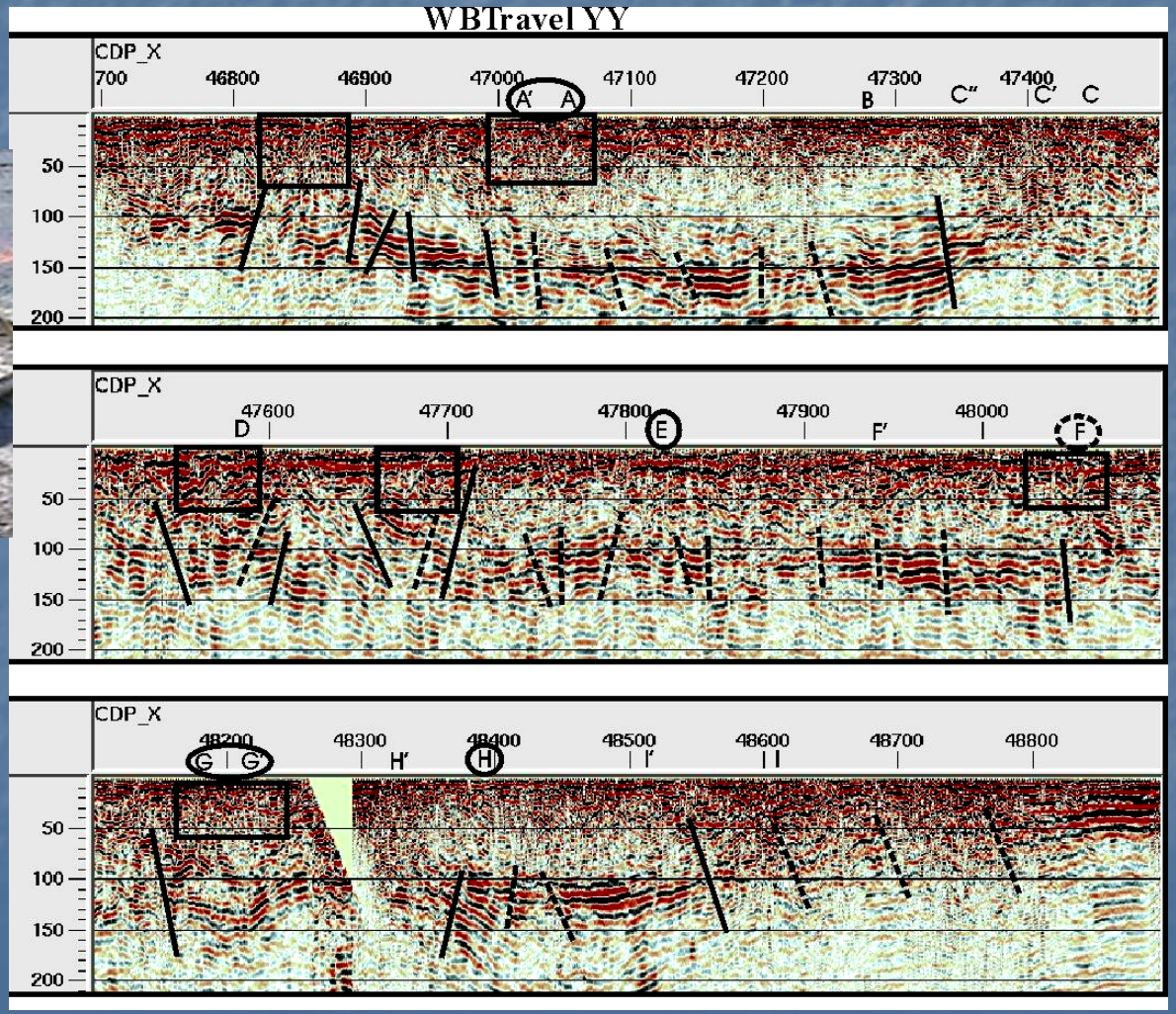


# Cross-hole GPR

# Seismic

- Reflection
- Refraction
- Cross-hole Velocity Logging
- Cross-hole Shear Wave Tomography
- Spectral Analysis of Surface Waves (SASW)

# Reflection


WBTravel YY
CDP_X
700
46800
46900
47000
47100
47200
47300
47400
A′
A
B
C″
C′
C
50
100
150
200
CDP_X
47600
47700
47800
47900
48000
D
E
F′
F
50
100
150
200
CDP_X
48200
48300
48400
48500
48600
48700
48800
G
G′
H′
H
I′
50
100
150
200

# Cross-hole Seismic

# Subsurface Characterization

## *New Bridge Foundation*

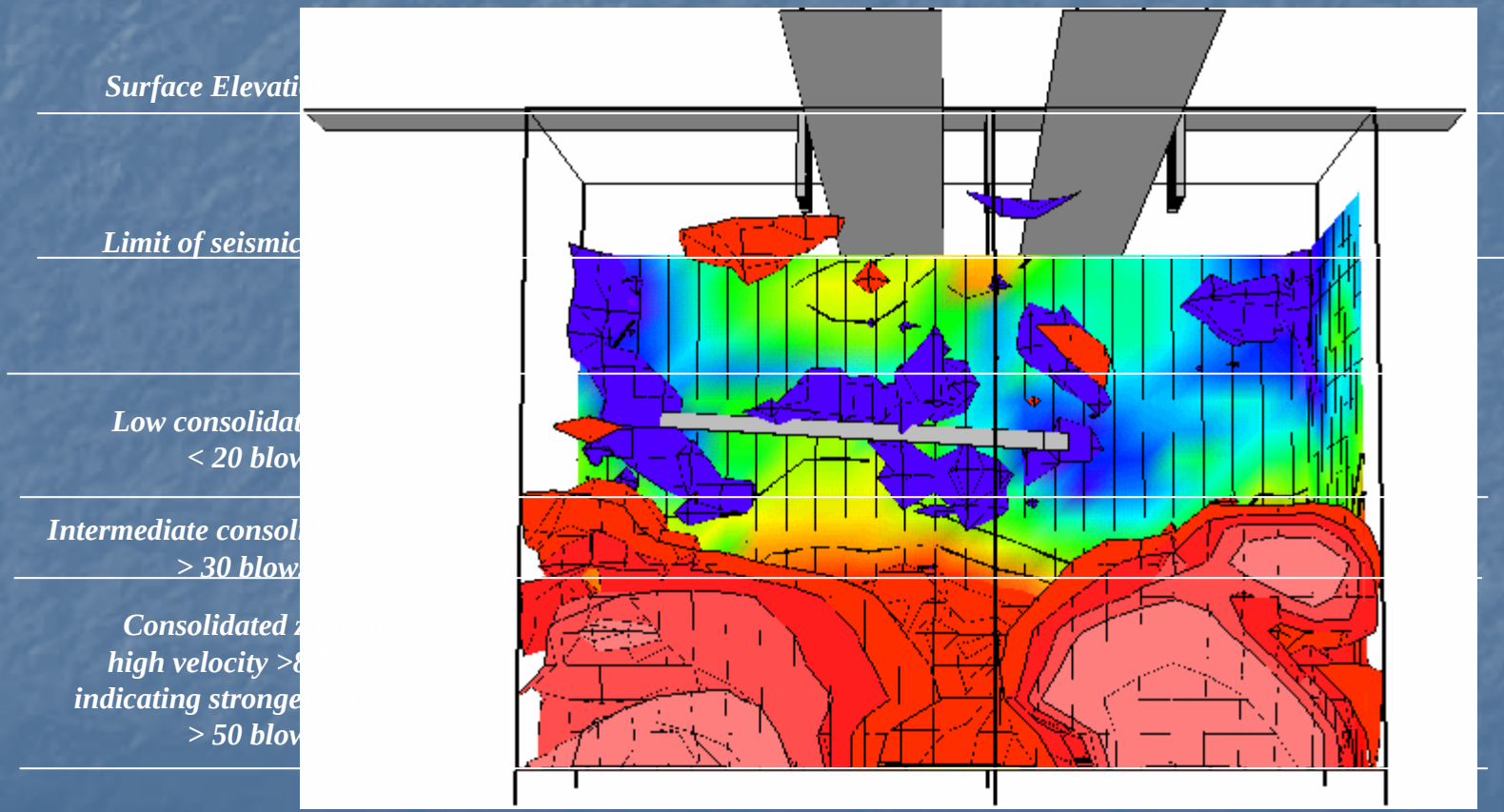
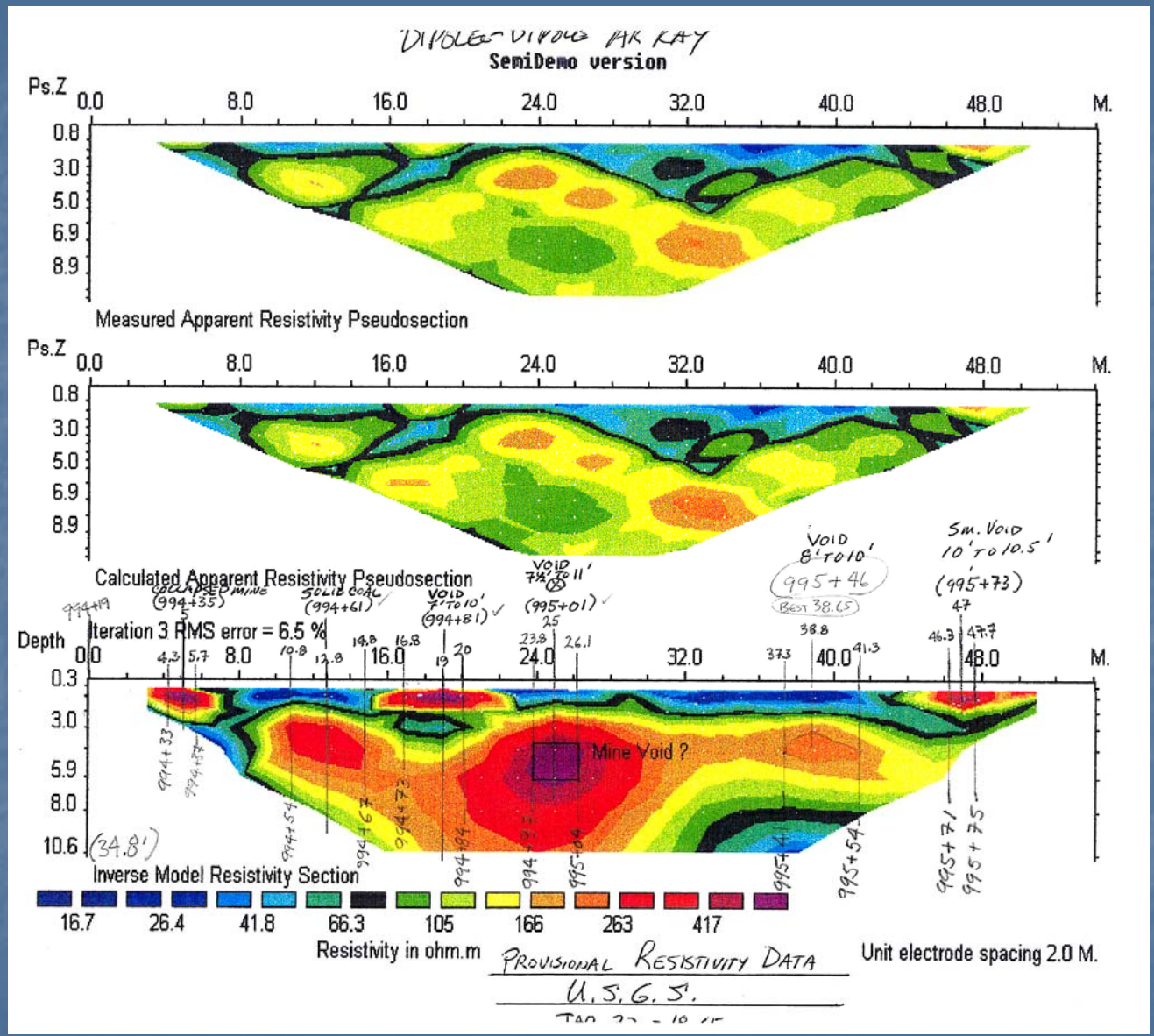
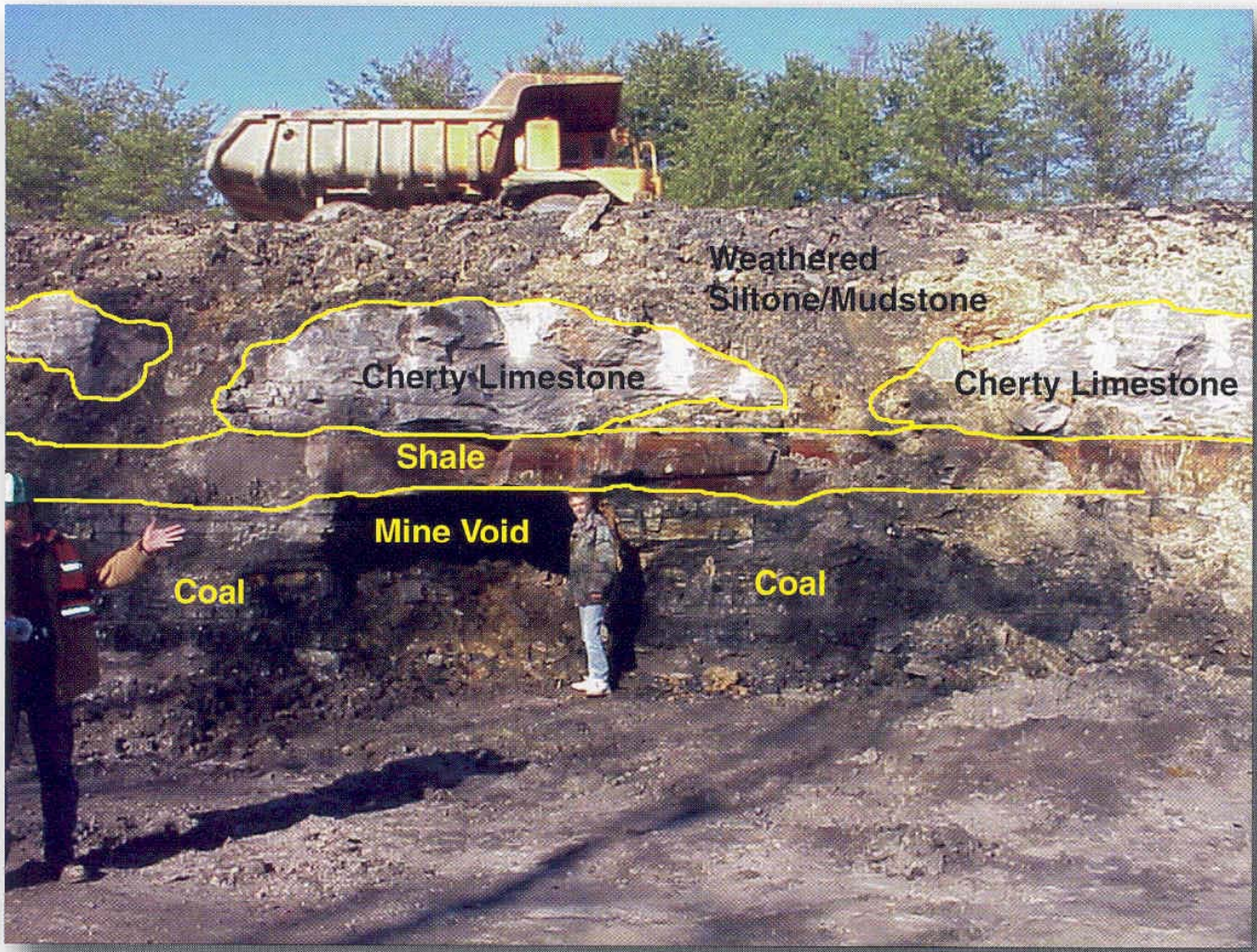



Figure 1. 3-D tomographic image showing tunnel location and selected velocity contours.

# Resistivity

Photo courtesy of Geometrics, Inc.


DIPOLE-DIPOLE RAY KAY
SemiDemo version
Ps.Z
0.0
8.0
16.0
24.0
32.0
40.0
48.0
M.
0.8
3.0
5.0
6.9
8.9
Measured Apparent Resistivity Pseudosection
Calculated Apparent Resistivity Pseudosection
Iteration 3 RMS error = 6.5 %
Depth
0.3
5.9
10.6
(34.8')
COLLAPSED MINE (994+35)
SOLID COAL (994+61)
VOID 7' TO 10' (994+81)
VOID 7½' TO 11' (995+01)
VOID 8' TO 10' 995+46 BEST 38.65
SM. VOID 10' TO 10.5' (995+73)
Mine Void ?
Inverse Model Resistivity Section
16.7
26.4
41.8
66.3
105
166
263
417
Resistivity in ohm.m
PROVISIONAL RESISTIVITY DATA
U.S.G.S.
Unit electrode spacing 2.0 M.

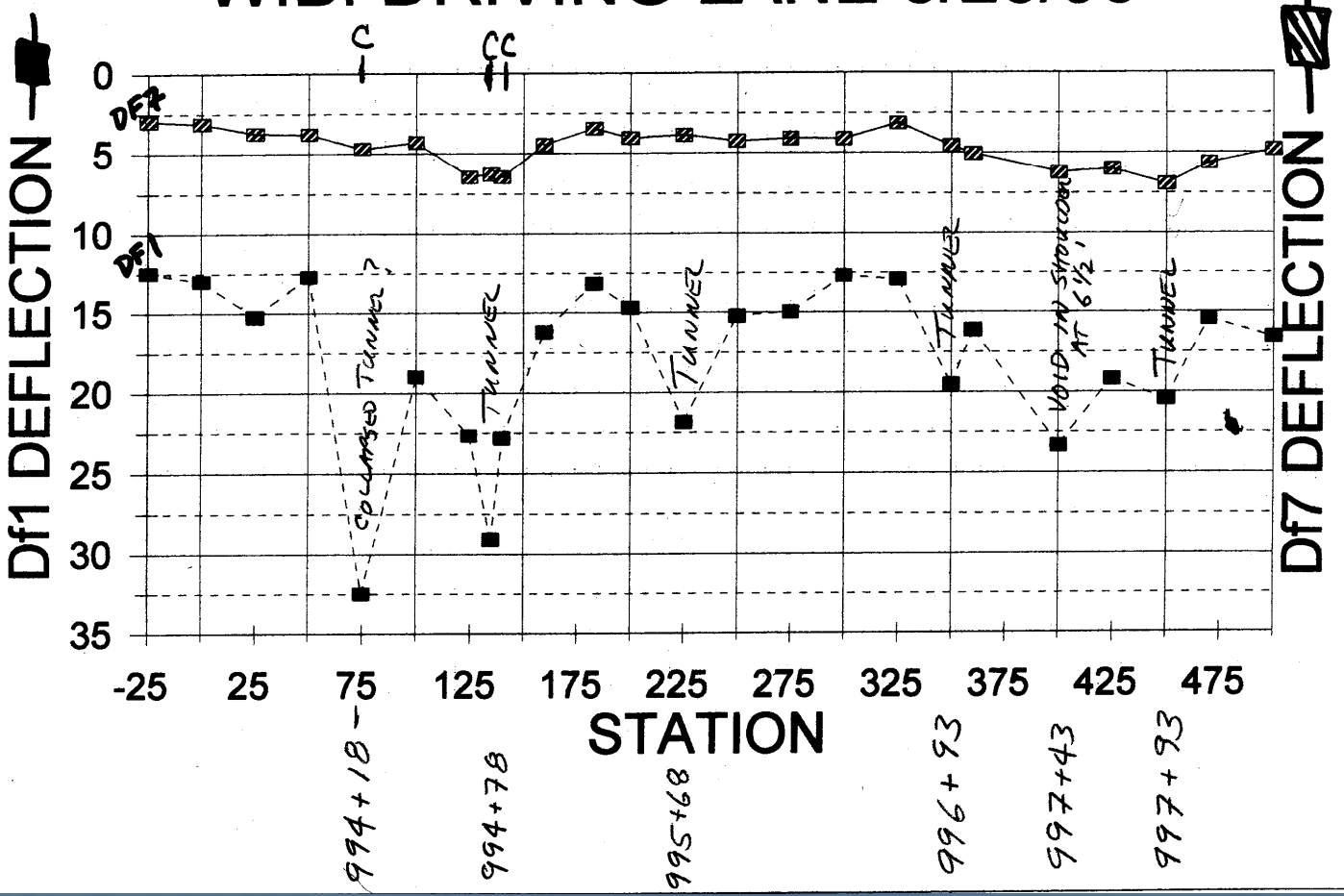



U.S. Department of the Interior
U.S. Geological Survey

# Falling Weight Deflectometer

# FWD DATA: JAC-32-18.65

## W.B. DRIVING LANE 5/28/98

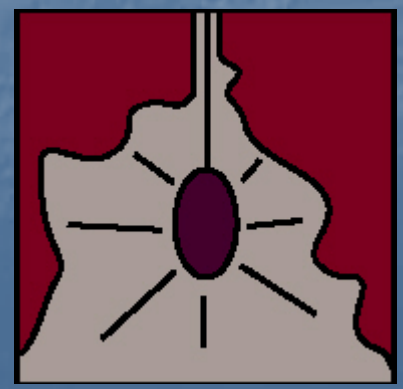


# Profilometer

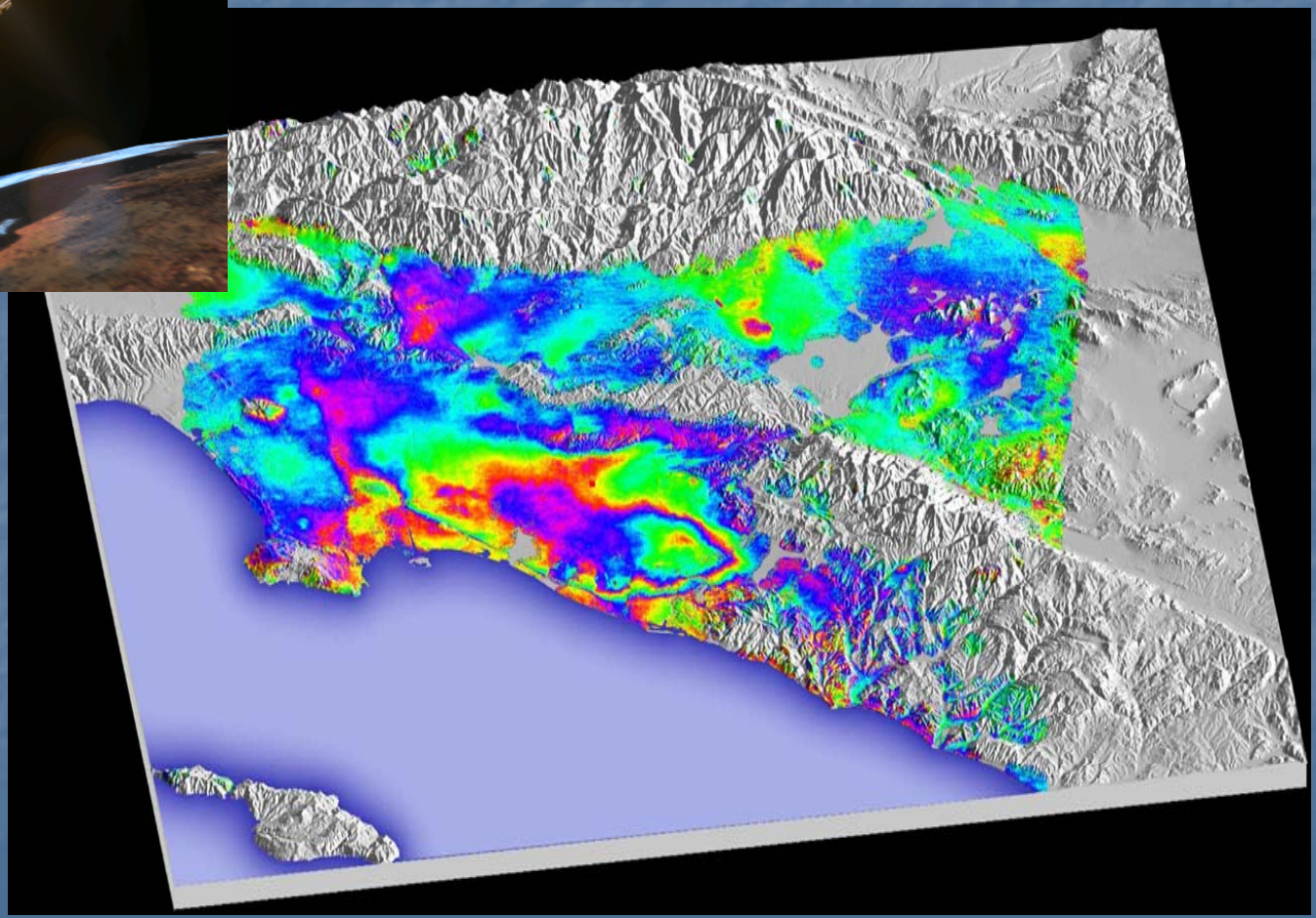
# Vertical
# Time Domain Reflectometry (TDR)

# Horizontal Time Domain Reflectometry (TDR)

# Cavity Auto Laser Scanner
# - provide 3D imagine

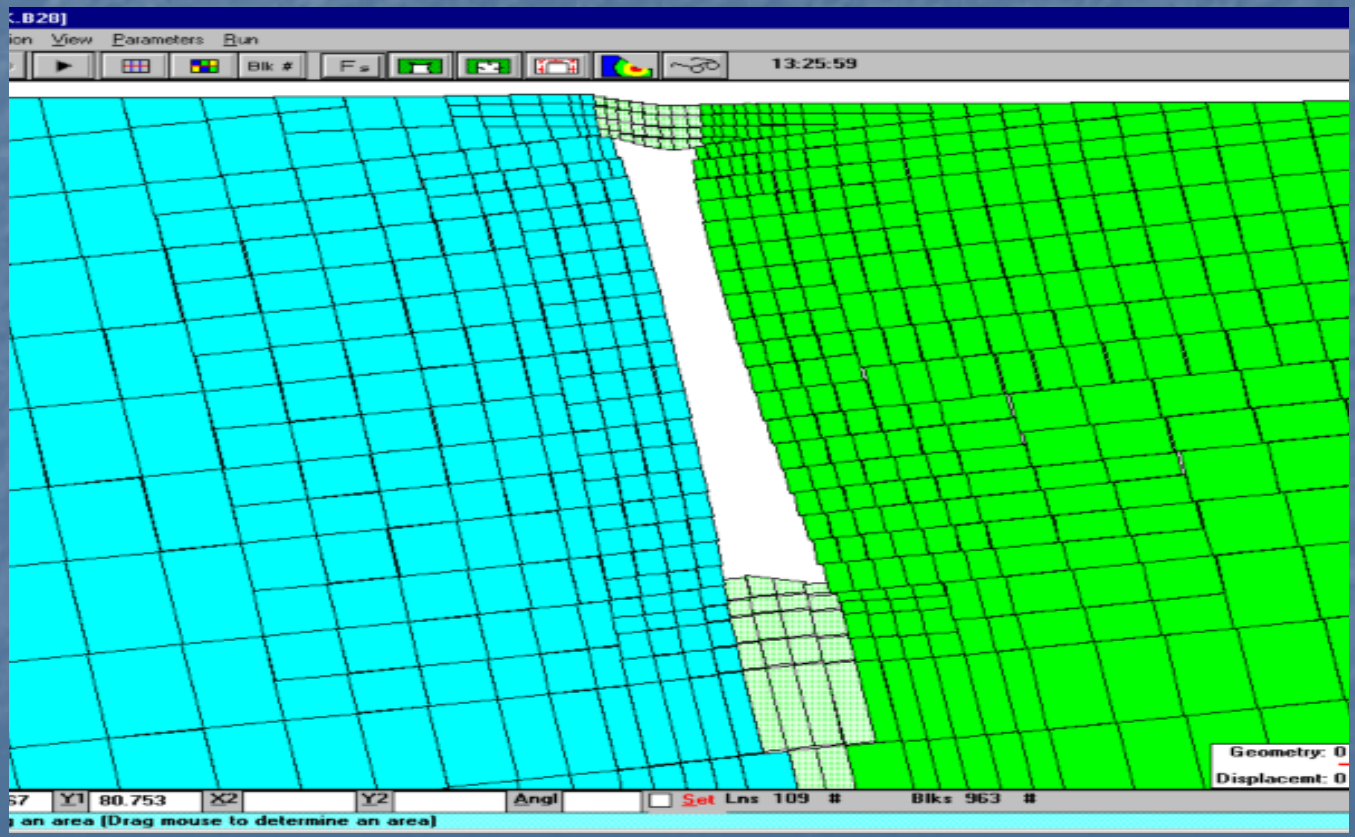


# Synthetic Aperture Radar Interferometry



# What Is Numerical Modeling?

**Simulation of material behaviour under imposed conditions using computational techniques (equation solving).**



MANUAL FOR

# ABANDONED UNDERGROUND MINE INVENTORY AND RISK ASSESSMENT

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

MAY 15, 1998

The State of Ohio is an
Equal Opportunity Employer

# Interstate Technical Group on Abandoned Underground Mines

- Alabama
- Arizona
- Canada
- FHWA
- FRA
- Illinois
- Indiana
- Iowa
- Kentucky
- Maryland
- Michigan
- Missouri
- Nevada
- New Jersey
- New York
- North Carolina
- North Dakota
- Ohio
- Ontario
- Pennsylvania
- Pennsylvania Turnpike
- Virginia
- West Virginia

Home
Group Information
Workshops
Mine Manual
Group History
Discussion
TRB Mine Subcommittee
Links

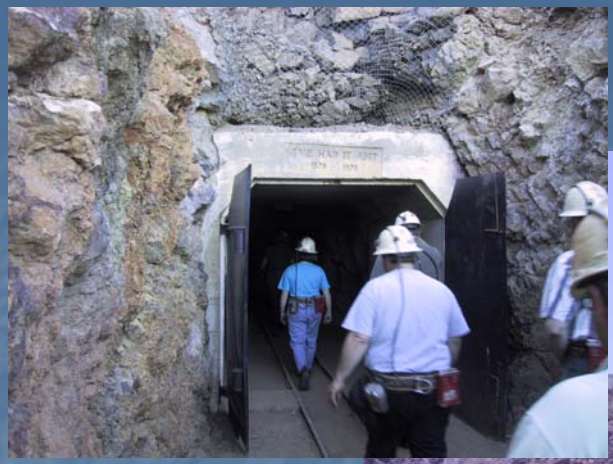
# Interstate Technical Group on Abandoned Underground Mines

I-70 EB Travel Lane, Ohio, 7:00 pm Saturday March 4, 1995

"*Sinkholes don't have a conscience.*" - Bruce Beechie, North Dakota Public Service Commission

**www.fhwa.dot.gov/mine**

# ARIZONA



April 21-23, 2004

# Next Workshop

- Rochester, New York
- June 13-15, 2006
- Contact:

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- More information:
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